

REDUCING NUCLEAR AND RADIOLOGICAL TERRORISM THREATS

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ABSTRACT

Urgent actions are needed to prevent a nuclear or radiological 9/11. Terrorists are actively seeking nuclear weapons and Radiological Dispersal Devices (RDDs) and the materials to make them. There are scores of sites where the essential ingredients of nuclear weapons exist, in dozens of countries worldwide. There are thousands of sites worldwide where radiological materials exist. Many of these sites are not sufficiently secured to defeat the kinds of threats that terrorists and criminals have demonstrated they can pose. A dangerous gap remains between the urgency of the threat of nuclear and radiological terrorism and the scope and pace of the U.S. and world response. While the gap has narrowed significantly in recent years, much more needs to be done. This paper describes the nuclear and radiological terrorism threats, analyzes the actions taken so far to address these threats, and recommends further actions going forward.

INTRODUCTION: THE EVOLVING THREAT

Nuclear terrorism remains a real and urgent danger. Despite the post-9/11 disruptions it has faced, the evidence suggests that al Qaeda continues to seek nuclear weapons and the materials and expertise to make them. In his memoir, former Director of Central Intelligence George Tenet provides frightening new information on al Qaeda's nuclear efforts – including a report from a senior al Qaeda operative that the group's nuclear weapons program had advanced to the point of conventional explosive testing. Tenet says that he is “convinced” that Osama bin Laden still “desperately” wants a nuclear bomb.¹ The 2006 call from the leader of al Qaeda in Iraq for “nuclear scientists” to join the jihad highlights the continuing threat.² The removal of al Qaeda's sanctuary in Taliban-led Afghanistan and the disruption of al Qaeda's central command reduced, but did not eliminate, the risk of such complex attacks. Unfortunately, al Qaeda's central leadership appears to be reconstituting itself, primarily in the Pakistan-Afghanistan border areas, and “retains the ability to organize complex, mass-casualty attacks,” according to Lt. Gen. Michael Maples, the director of the Defense Intelligence Agency.³

Similarly, there is substantial evidence that al Qaeda and the global jihadi network it has spawned have repeatedly sought radioactive material for a radiological dispersal device (RDD), and considered attacking nuclear power plants. (Indeed, both Khalid Sheikh Mohammed and Mohammed Atta considered including nuclear power plants in the 9/11 targets, but put this effort as too uncertain.⁴) In two recent cases, al Qaeda affiliated groups have been apprehended while planning to acquire radioactive materials for “dirty bomb”-attacks. In August 2004, British police arrested Dhiren Barot, leader of a group of eight men, which planned to carry out multiple terrorist attacks in Britain and in the United States. Among the group's plans was setting on fire ten thousand household smoke detectors to disperse the small amounts of americium which they hold.⁵ In January 2005, German police arrested an Iraqi and a Palestinian who unsuccessfully attempted to acquire 46 grams of highly enriched uranium from a group in Luxembourg, allegedly on behalf of al Qaeda.⁶ Both these plots involve radioactive materials in types or quantities that would not cause much damage if used as an RDD, but they demonstrate the interest of jihadi extremists in mounting RDD attacks.

Highly enriched uranium (HEU) or separated plutonium, the essential ingredients of nuclear weapons, exist in hundreds of buildings at scores of sites in dozens of countries around the world. Security at some of these buildings is excellent; at others, it amounts to little more than a night watchman and a chain-link fence.⁷ Many sites have security and control measures that are demonstrably insufficient to defeat the kinds of sophisticated insider conspiracies or large-scale outsider attacks that terrorists and criminals have successfully carried out in a variety of countries around the world.

In Russia, security for nuclear stockpiles has improved substantially since the 1990s; it is unlikely that the “one person with no particular plan” threats that carried out successful nuclear thefts in the 1990s could do so at any nuclear facilities in the former Soviet Union today. But these improved security systems face dangerously large insider and outsider threats. The 2006 firing of Major General Sergey Shlyapuzhnikov, deputy chairman of the section of the Ministry of Interior (MVD) responsible for law and order in the closed territories (including the closed nuclear cities), for helping to organize smuggling in and out of those closed territories is an indicator of the systemic corruption that creates dangerous possibilities for sophisticated insider conspiracies.⁸ And the confirmation by senior Russian officials that terrorist teams have been carrying out reconnaissance at Russian nuclear weapon storage sites – combined with non-nuclear incidents in which scores of heavily armed and well-trained terrorists have struck without warning – suggests the magnitude of the outsider threat.⁹

Similarly, in Pakistan, nuclear insiders have met with bin Laden to discuss nuclear weapons, and have marketed sensitive nuclear technologies around the world; and the outsider threat includes both a reconstituted al Qaeda and a wide range of other jihadi groups. Serving Pakistani military officers cooperating with al Qaeda operatives have twice come close to assassinating the Pakistani president;¹⁰ who can be confident that officers guarding nuclear weapons will never cooperate with al Qaeda?

Research reactors fueled with HEU pose another high-priority nuclear theft risk, as many are in difficult-to-defend locations such as university campuses, and have only the most modest security measures in place. Of course, other stockpiles of nuclear weapons and materials also pose theft risks that must be addressed. The seizure of stolen 89% enriched HEU in Georgia in early 2006 is a stark reminder that nuclear theft and smuggling is an ongoing reality.¹¹

Successful sabotage of a major nuclear facility could cause a Chernobyl-scale catastrophe, though existing security and safety systems mean that it would not be easy for terrorists to cause such a disaster. Here, too, security measures require urgent improvement in many cases; some countries, for example, still have no armed guards at nuclear facilities (relying on armed response forces 10-15 minutes away), while tests in the United States and elsewhere suggest that the time required for well-trained and well-armed attackers to sabotage a plant may be too short for such outside defenders to arrive. In addition to improved security, in many cases relatively straightforward safety measures can also reduce risks significantly (such as not densely packing hot, recently-discharged fuel in the most easily-drained pools). The possibility of terrorism increases the motivation for “inherent” safety in the design of future nuclear power plants; at a minimum, the safety systems of such plants should be designed to make it even more difficult for either insiders or outsiders to cause a catastrophic nuclear radiation release.

Control of dangerous radiological sources is an even more difficult challenge. Potentially dangerous sources exist at thousands of sites worldwide, in almost every country. Many countries in which radioactive sources are used lack even the most basic control and accounting standards.¹² Disposal of obsolete sources is often not regulated or insufficiently regulated. Even in advanced industrial economies, such sources typically have minimal security measures (particularly when they are being transported) and may become a target for terrorist cells working inside of these countries. The overall risk of radiological terrorism can be reduced by improving security for the most dangerous sources, removing sources from hundreds of sites (especially obsolete and excess sources), and improving preparations to respond to an RDD attack (including effective public communication strategies to reduce the resulting panic).¹³

Getting nuclear material, making a nuclear bomb from it, and delivering that bomb would be the most complex and challenging operation any terrorist group has ever carried out. Nevertheless, the possibility is very real – and the consequences would be a catastrophe of almost unimaginable proportions. This is a global threat: former UN Secretary General warned that the global economic reverberations would push “tens of millions of people into dire poverty,” creating “a second death toll throughout the developing world.”¹⁴ The materials required for an RDD attack are far more widely available, and the technological hurdles facing the terrorists far less daunting, making an RDD attack much more likely than an attack with nuclear explosives. But an RDD attack would be much less catastrophic, killing relatively small numbers of people (if anyone); it could, however, require the evacuation of a substantial area, create widespread panic,

and lead to billions of dollars in cleanup costs and economic destruction. Overall, we judge that the risk – conceived as probability multiplied by consequences – of potential nuclear explosive terrorism is greater, giving the history-changing scale of the consequences of such an attack, but reasonable people disagree. Both the probability and the consequences of a major sabotage are intermediate between those of a nuclear explosive and an RDD attack.

NEXT STEPS TO REDUCE THE THREAT OF NUCLEAR WEAPONS TERRORISM

Urgent steps are needed to ensure that every nuclear weapon and every significant cache of weapons-usable nuclear material worldwide is sustainably secured and accounted for, to standards sufficient to defeat the threats that terrorists and criminals have shown they can pose. To get these stockpiles locked down before terrorists and thieves can get to them will require several steps:

- **A global campaign to prevent nuclear terrorism.** Nuclear theft and terrorism are global dangers requiring global responses. President Bush, working with other world leaders, should launch a fast-paced global campaign to prevent nuclear terrorism. This effort must be at the center of U.S. national security policy and diplomacy; it should be pressed forward with every country with stockpiles to secure or resources to help, at every level, at every opportunity, until the job is done. This campaign should creatively and flexibly integrate a broad range of policy tools to achieve the objective – from technical experts cooperating to install improved security systems at particular sites to Presidents and Prime Ministers meeting to overcome obstacles to cooperation. The recently launched Global Initiative to Combat Nuclear Terrorism will be one, but only one, of these policy tools.
- **Effective global nuclear security standards.** As part of this global campaign, President Bush and other leaders of major nuclear weapon and nuclear energy states should immediately seek agreement on a broad political commitment to meet at least a common minimum standard of nuclear security. Effective global standards are urgently needed, for in the face of terrorists with global reach, nuclear security is only as good as its weakest link. The standard should be rigorous enough that all stockpiles with such security measures are well protected against plausible insider and outsider threats, but flexible enough to allow each country to take its own approach to nuclear security and to protect its nuclear secrets. For example, the agreed global standard might be that all nuclear weapons and significant caches of weapons-usable nuclear materials be protected at least against two small groups of well-armed and well-trained outsiders, one to two well-placed insiders, or both outsiders and insiders working together. Where countries believe bigger threats are possible, they should provide greater protection. UN Security Council Resolution already legally requires every state to provide “appropriate effective” security and accounting for whatever nuclear stockpiles it may have; if leading states could agree on what the essential elements of an “appropriate effective” nuclear security system are, and then begin helping (and pressuring) states to put those essential elements in place, this could form the core of a global standard. If the words “appropriate effective” mean anything, they should mean that nuclear security systems could effectively defeat threats that terrorists and criminals have demonstrated. Similarly, in the new revision of the IAEA’s physical protection recommendations now beginning to be discussed, the United States and other leading states should seek agreement to include a minimum design basis threat such as the one just discussed.
- **An accelerated and expanded “global cleanout.”** The only foolproof way to ensure that nuclear material will not be stolen from a particular site is to remove it. As a central part of the global campaign to prevent nuclear terrorism, the United States should immediately begin working with other countries to take steps to accelerate and expand the removal of weapons-usable nuclear material from vulnerable sites around the world. The goal should be to remove all nuclear material from the world’s most vulnerable sites within four years—substantially upgrading security wherever that cannot be accomplished—and to eliminate all HEU from civil sites worldwide within roughly a decade. That is a challenging goal, but potentially achievable with sustained high-level leadership. This effort should include targeted incentives to convince research reactors and related facilities to convert from HEU to low-enriched uranium (LEU) or to shut down; a new emphasis on convincing unneeded research reactors to shut down

(which for many aging reactors will be a more appropriate and faster option than conversion); a continuing effort to expand the conversion or shutdown effort to cover as large a fraction of the world's HEU-fueled research reactors as possible; and expanded efforts to remove a larger fraction of the potentially vulnerable nuclear material around the world.¹⁵ To maintain the trust needed to convince reactor operators to convert to LEU, however, a shut-down effort should probably be institutionally separate from the conversion effort – perhaps under the rubric of a “Sound Nuclear Science Initiative” focused on ensuring that the world gets the highest-quality research, training, and isotope production out of the smallest number of safe and secure reactors at the lowest cost.

The fundamental key to the success of such a global effort is to convince political leaders and nuclear managers around the world that nuclear terrorism is a real and urgent threat to *their* countries' security, worthy of a substantial investment of their time and money. The United States and other countries should take several steps to build the needed sense of urgency and commitment, including:

- **Joint threat briefings.** Upcoming summits with political leaders of key countries should include detailed briefings for both leaders on the nuclear terrorism threat, given jointly by U.S. experts and experts from the country concerned. These would outline both the very real possibility that terrorists could get nuclear material and make a nuclear bomb, and the global economic and political effects of a terrorist nuclear attack.
- **Nuclear terrorism exercises and war games.** The United States and other leading countries should organize a series of exercises and war games with senior policymakers from key states, with scenarios tailored to the circumstances of each country or region where the exercises take place. Participating in such a war game can reach officials emotionally in a way that briefings and policy memos cannot.
- **Fast-paced nuclear security reviews.** The United States and other leading countries should encourage leaders of key states to pick teams of security experts they trust to conduct fast-paced reviews of nuclear security in their countries, assessing whether facilities are adequately protected against a set of clearly-defined threats. (In the United States, such fast-paced reviews after major incidents such as 9/11 have often revealed a wide range of vulnerabilities that needed to be fixed.)
- **Realistic testing of nuclear security performance.** The United States and other leading countries should work with key states around the world to implement programs to conduct realistic tests of nuclear security systems' ability to defeat either insiders or outsiders. (Failures in such tests can be powerful evidence to senior policymakers that nuclear security needs improvement.)
- **Shared databases of threats and incidents.** The United States and other key countries should collaborate to create shared databases of unclassified information on actual security incidents (both at nuclear sites and at non-nuclear guarded facilities) that offer lessons for policymakers and facility managers to consider in deciding on nuclear security levels and particular threats to defend against.

The nuclear industry has a direct self-interest in the success of such efforts, for a “security Chernobyl” resulting from a successful sabotage of a nuclear plant or a nuclear theft leading to nuclear terrorism would be not only a human catastrophe but an industry disaster, ending any plausible chance for a large-scale nuclear renaissance. Hence, complementing government efforts, the nuclear industry should launch its own initiative focused on bringing the worst security performers up to the level of the best performers, through defining and exchanging best practices, industry peer reviews, and similar measures—a World Institute for Nuclear Security (WINS) on the model of the World Association of Nuclear Operators (WANO) established to improve global nuclear safety after the Chernobyl accident. Such an effort could be a critical part of convincing nuclear managers of the reality and urgency of the threat.

As the current U.S.-funded security equipment upgrade programs in Russia near their scheduled completion at the end of 2008, it is time to focus additional attention on (a) ensuring that the other elements of an effective nuclear security and accounting system are put in place; and (b) making similar progress in improving nuclear security throughout the world. Particularly important elements of an effective system, beyond modern security, control, and accounting equipment and appropriate training, include:

- **Sustainability.** The goal of permanently reducing the danger of nuclear terrorism will not be achieved if the equipment now being installed is broken and unused five years after U.S. assistance comes to an end.

The recent Department of Energy (DOE)-Rosatom sustainability agreement is an excellent first step. But a great deal remains to be done: in particular, the resources Russia is devoting to nuclear security and accounting remain only a fraction of what is needed to maintain effective systems for the long haul.

- **Security culture.** Here too, notable progress has been made with Rosatom since the 2005 Bratislava summit, but much more remains to be done. The key to success will be convincing all security-relevant staff of the reality and urgency of the threat of nuclear theft and terrorism; many are not convinced today. Changing ingrained security cultures is a difficult challenge, as continuing U.S. problems at Los Alamos demonstrate. Sustained leadership from the top management of all relevant facilities will be needed. As every dollar a facility manager spends on security is a dollar not spent on activities that might bring in revenue or meet his facility's primary mission, and every hour spent following security procedures is an hour not spent on activities more likely to gain an employee a raise or promotion, the incentives to cut corners on security are strong; it is essential to put in place strong incentives for good security.¹⁶
- **Regulation.** Most nuclear security managers will only invest in expensive nuclear security measures if they are required to by the government. Hence, effective nuclear security rules, effectively enforced, are absolutely critical to achieving effective and sustainable security. Russia's nuclear security and accounting regulations are still weak, and its nuclear regulators have far less power than the agencies they are supposed to regulate. Over the next several years, the United States should make effective nuclear security and accounting regulation a major focus of its nuclear security cooperation with Russia – and with other countries around the world.
- **Well-equipped, well-trained, and well-motivated guard forces.** High-quality response forces are essential to good nuclear security, particularly against outsider threats. While the United States has provided response force equipment and training, at many sites in Russia, the response forces remain poorly paid and poorly trained conscripts prone to high rates of corruption and suicide.¹⁷ Over time, it is essential to work with Russia and other states to ensure that nuclear stockpiles are guarded by professional guard forces, with the training, equipment, numbers, and motivation needed to do the job.
- **Improved defenses against insider threats.** Improved material protection, control, and accounting systems are only part of the answer to the insider threat. Programs to combat corruption, to improve screening and monitoring of those granted access to nuclear material, to ensure that hands-on access to these stockpiles is minimized and constantly observed and controlled, are also essential; new initiatives should be launched in each of these areas to reduce the risk.

These steps, of course, are needed not just in Russia, but wherever nuclear weapons and weapons-usable nuclear material exist. In particular, no one should assume that all stockpiles in wealthy countries are automatically secure; even in the United States, for example, only the most minimal security measures are in place for HEU-fueled research reactors licensed by the Nuclear Regulatory Commission.¹⁸ The global campaign will have to be exactly that – a global effort, focused on removing or securing every cache of these materials in scores of countries worldwide.

NEXT STEPS TO REDUCE THE THREAT OF RADIOLOGICAL TERRORISM

Urgent steps are also needed to reduce the risks of radiological terrorism (both from nuclear sabotage and from RDDs), including both greater resources and more high-level political attention to the problem. Many of the steps recommended above for nuclear weapons and materials are needed here as well, including a global campaign to reduce the risks; effective global security standards; a global effort to remove dangerous materials entirely wherever possible; effective rules on security and control, effectively enforced; a focused effort to strengthen security cultures and ensure the sustainability of improved security measures; and improved measures to cope with insider threats. In the case of radiological terrorism, as in the case of nuclear terrorism, success will depend on convincing key officials and facility managers of the reality and urgency of the threat.

Protecting major nuclear facilities from sabotage, like protecting against nuclear theft, involves a relatively limited number of high-value sites where improved security provides high leverage in reducing the

risk. As next steps: (a) all states should enact and enforce security rules ensuring that all nuclear facilities with the potential for catastrophic sabotage are well-protected against the outsider and insider capabilities terrorists have demonstrated in that country; (b) donor states should add protection of major nuclear facilities to their threat-reduction agenda, given the widespread human consequences and the global consequences for the nuclear industry in event of a successful sabotage; (c) all states with major nuclear facilities should assess whether cost-effective steps could be taken to significantly reduce the consequences of particular sabotage scenarios (such as ensuring that spent fuel in pools is not sufficiently packed to create a significant risk of a zirconium fire in the event of a pool-draining attack), and should implement all cost-effective measures identified; (d) the IAEA's physical protection recommendations should be modified to provide more detail on the steps states should take to protect against sabotage; and (e) future major nuclear facilities should be designed from the outset to minimize sabotage risks. Given the nuclear industry's large self-interest in preventing a successful sabotage anywhere, the industry security initiative recommended above should make sabotage protection a major priority.

Potentially dangerous radiological sources are far more dispersed, and in most cases only comparatively modest security measures can practically be put in place. But improved security, control, and accounting of these sources can make terrorists' job significantly harder, and in the case of RDDs the consequences can be reduced significantly through better preparation and public communication strategies. Steps that should be taken include::

- **Instituting cradle-to-grave security, control, and accounting measures where controls are now weakest.** Like nuclear materials, many radiological materials could readily be transported from one country to another, once in terrorist hands. It is therefore critical that all countries – including developing countries that may have modest expertise and resources to devote to this problem – provide appropriate security measures for dangerous radiological sources and effective, cradle-to-grave control and accounting of the sources within their borders, at least to the levels called for in the IAEA Code of Conduct. This must include measures for appropriate removal and disposal of orphan or unneeded sources. Donor states should increase their emphasis on helping states put such controls in place. The U.S. Global Threat Reduction Initiative (GTRI) has been working with other countries and the IAEA to improve security at more than 3000 high-risk sites worldwide.¹⁹ For example, hundreds of potentially deadly operational radioisotope thermoelectric generators (RTG) in Russia have been secured, though hundreds more remain to be addressed.²⁰ Unfortunately, GTRI's budget for radiological security and removal has been cut dramatically in recent years, and these efforts are currently not expected to be done until 2028. The United States should reverse these budget cutbacks and other leading countries should contribute, so as substantially accelerate this schedule. Of particular concern for the United States are also the states of Latin America, given the inadequate controls on radiological sources there, the significant organized crime and terrorist activity, and the large-scale smuggling routes to the United States that are already established.²¹
- **Improving security for radioactive sources in developed states.** Recent foiled and successful terrorist plots in Europe and the United States make clear that domestic terrorist cells are an important part of the danger in these countries – and in the recent radiological cases in Europe, the would-be perpetrators were apparently seeking to acquire the material locally (in the German case from Luxembourg, but there is essentially no border control between the two states).²² Clearly concern over security for radiological sources must include security in advanced developed states as well. Recent studies of the situation in Germany²³ and Canada²⁴ have shown that even in countries with already high standards for safety and security and functioning oversight institutions, sources may still be vulnerable to theft by relatively unsophisticated groups using criminal tactics. Hospitals, industrial facilities, and transporters need to introduce at least modest security improvements, including alarm systems and surveillance cameras. These facilities also need to analyse their work procedures and routines, quickly eliminating the most obvious weak points. In the case of transport of the most dangerous sources, there should be background checks for drivers, locks and barriers that would make removal of the source very difficult, and at least one armed guard. In the United States, some government agency should be given the mission and

funding to help domestic licensees that may have inadequate resources and expertise with providing security for dangerous sources. Most importantly, the Department of Homeland Security and the Nuclear Regulatory Commission must work closely with users of radiation sources to promote a change in thinking about security and raise awareness that these materials are a potential target for terrorists.

- **Improving emergency response capabilities.** Radiological weapons must now be considered part of the canon of potential terrorist methods. Therefore it is of great importance that emergency responders, especially fire-fighters, police and paramedics in every city be adequately trained and equipped to cope with a radiological attack. The U.S. national laboratories and universities today have significant information concerning the likely consequences of a radiological attack and the measures that need to be taken in the immediate aftermath, which needs to be conveyed to first responders and integrated in their training.²⁵ Simple, robust radiation detectors should become part of the equipment of every fire company and should routinely be employed in every suspicious fire or explosion. Tabletop exercises featuring radiological attack scenarios and involving all relevant branches of the local and city governments, fire and police departments, and emergency medical services should be conducted on a regular basis. Plans for evacuation, cleanup, and reoccupation and reuse of contaminated areas should be made now, with standards modified to minimize the damage and disruption that a dirty-bomb attack would cause.²⁶ Local and state governments should devise effective and credible strategies for communication with the population in the affected and neighbouring areas, preferably in co-operation with local media.
- **Improving detection capabilities at borders and in population centers.** Radiation detectors at border crossings and sea ports are an important part of the effort to reduce the danger of nuclear or radiological terrorism, and hundreds of millions of dollars have been spent installing improved detection capabilities in many countries over the past decade.²⁷ But the contribution that fixed, easily observable detectors can make should not be overstated: HEU and many radioactive materials of concern emit relatively little detectable radiation, if properly shielded, and terrorists are likely to take other routes that do not go by a detector. Nevertheless, some investment in deploying detectors and developing new detector technologies and approaches is clearly warranted. Detector networks could also provide an early warning system for accidental or covert releases of radioactivity.

CONCLUSION

Much has been done to reduce the risk of nuclear and radiological terrorism over the past fifteen years. The funds invested have represented an excellent investment in U.S. and world security. But a great deal more remains to be done. A sea-change in the level of sustained attention to these issues from the highest levels of government in the United States and around the world is urgently needed if the world is to avoid a nuclear or radiological 9/11.

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